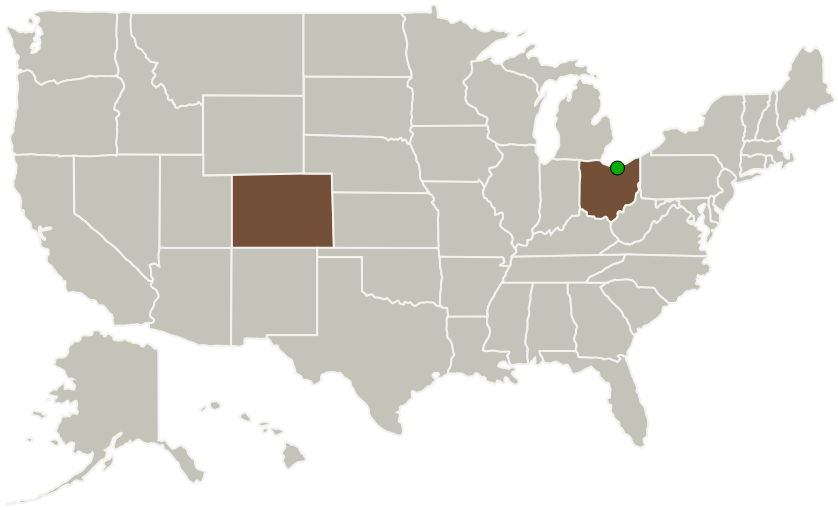
Predicting Hall Thruster Operational Lifetime Using a Kinetic Plasma Model and a Molecular Dynamics Simulation Method, Phase I

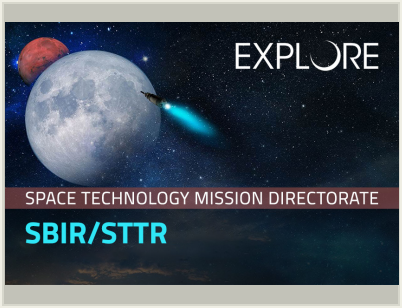
Completed Technology Project (2011 - 2011)

Project Introduction

Hall thrusters are being considered for many space missions because their high specific impulse delivers a larger payload mass fraction than chemical rockets. With a low thrust, however, Hall thrusters need to operate for a long period of time to achieve the necessary velocity of the mission. For these missions, the lifetime requirements can reach into tens of thousands of hours. For Hall thrusters, the most important life-limiting process is the erosion of the channel walls. However, experimental verification of lifetime is time-consuming and expensive. Therefore, computational method is a useful tool to predict thruster lifetime. Many of the Hall thruster lifetime models were developed, and some of theses models gave quite promising results. However, while qualitatively interesting, the results did not match well with experiment. The reason of this discrepancy is that these numerical models assume electrons as a fluid. The proposed innovation will provide a better understanding of the erosion physics and will be useful for future Hall thruster development, such as HiVHAc, with low cost and time. This tool also will allow to aid in the acceptance and implementation of Hall thrusters as a primary propulsion device through improving confidence of their long term reliability.

Primary U.S. Work Locations and Key Partners





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Organizations Performing Work	Role	Type	Location
Tech-X Corporation	Lead Organization	Industry	Boulder, Colorado
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
Colorado	Ohio

Project Transitions

February 2011: Project Start

August 2011: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138422)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Tech-X Corporation

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

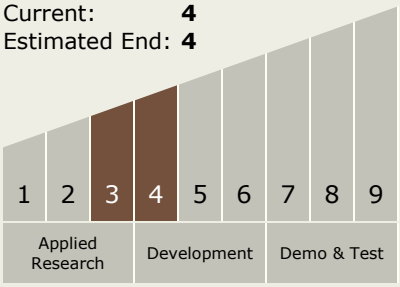
Carlos Torrez

Principal Investigator:

Yongjun Choi

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



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Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.2 Electric Space Propulsion
    - TX01.2.2 Electrostatic

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System